TAXONOMY AND DISTRIBUTION OF ERIODICTYON

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(WITH THREE FIGURES)

In 1905, Chancellor JORDAN (7), in reviving the isolation theory, presented the following general law: "Given any species in any region, the nearest related species is not likely to be found in the same region nor in a remote region, but in a neighboring district separated from the first by a barrier of some sort."

Botanists were not agreed as to the applicability of the law to plants, and LLOYD (8) even asserted that it "would be more in harmony with the facts in the case as understood by the botanists if stated in the converse form." At the time we were inclined to accept the law and offered (1) a number of illustrations in support. But it was obvious that very few data on the distribution of plants in this country were available. Few attempts had been made to map accurately the distribution of closely related species. Distributional notes in the manuals were of such a general nature that they were largely useless for such a study, and many of the herbarium specimens were but little better, the average collector's data being far too meager and often confusing. The need for careful distributional studies of closely related species seemed imperative, and with this in mind we have been collecting data on a number of Pacific Coast genera.

Eriodictyon was selected as one of the genera for these distributional studies for various reasons. The species constitute a single clearly defined natural group instead of an aggregate of groups, as is often the case with the larger genera; they are all evergreen shrubs readily detected in the field at all times of the year; and, finally, their center of distribution is in southern California, the region with which we are most familiar.

As originally recognized by BENTHAM (2) and GRAY (4) and as recently delimited by BRAND (3), the genus *Eriodictyon* comprises a small natural group of sclerophyllous shrubs peculiar to California and the Southwest, where they are commonly called

"Yerba Santa." All the species are essentially Upper Sonoran, but range in their zonal distribution from the upper edge of the Lower Sonoran to the Transition.

Propagation may be by seed or, at least in *E. californicum*, it may be by suckers; whole colonies or thickets are often connected by lateral roots that lie only three or four inches below the surface of the ground. In the xerophytic habitat where these plants usually grow, ability to propagate in this manner is an effective factor, for seedlings have difficulty withstanding the long dry seasons.

The leaves present striking examples of adaptations to xerophytic conditions, which fall into two categories. One type, represented by *E. californicum*, has the upper surface covered by sessile glands that give a smooth varnished appearance, and the lower surface conspicuously reticulate-veined with the stomatic surface in the sunken meshes clothed more or less densely with a short grayish tomentum. The palisade tissue is also prominent, comprising several tiers of cells. Other xerophytic adaptations in this type are mainly in the reduction of leaf surface; in *E. californicum*, an inhabitant of central and northern California, the normal leaf is flat and 10–15 mm. wide, while in *E. angustifolium*, of the Arizona mountains, where xerophytic conditions are more severe, the leaves are revolute and only 2–5 mm. wide.

In the other foliage type, represented by *E. crassifolium*, both surfaces of the leaves are clothed with thick-walled unicellular trichomes that form a dense mat over the entire surfaces. In *E. tomentosum* these trichomes stand out at right angles to the surface for a short distance, then turn sharply and interlace, forming a dense felt just above the surface; by this arrangement a sort of "ramada" is produced which shuts off the sun's rays and the hot winds, but allows slow diffusion. The palisade layer is much less developed than in the glutinous type, comprising a single tier of cells instead of several tiers. The leaves are also broader and never revolute.

It is evident that the members of the genus are adapted to xerophytic conditions, and that two diverse methods of meeting these conditions have been evolved. That the two types have

sprung from a common stock is also evident, for, as we shall show, there are forms still existing that comprise an almost unbroken series from the glutinous to the tomentose type.

FIG. 1.—*Eriodictyon crassifolium* Benth.: type specimen in the Bentham Herbarium at Kew Gardens.

Since *E. crassifolium*, a typical tomentose form, inhabits the San Diego region, and *E. californicum*, a glutinous form, the more humid central and northern California, it would indicate that a direct environmental influence was the causal factor in evolving the two types. That is to say, if specimens of the two types were grown under the same environment they would eventually become alike, but that is a point that remains as an enticing future problem. From the present studies, however, we learn that other members of the glutinous series occur in the San Bernardino Valley and even in the vicinity of Ensenada, Lower California, where they are subjected to more severe xerophytic conditions than are members of the tomentose type in the Los Angeles region. These distributional facts demonstrate that the glutinous forms may be as well fitted to a xerophytic environment as those of the tomentose group. We may with equal propriety, therefore, suggest that the two groups represent two strains of a common stock that have developed independently. This theory is borne out further by the fact that forms of the two groups growing in contiguous territories more or less intergrade where they meet; while in isolated regions, where only one strain is represented, no marked variation occurs even in strikingly different environmental conditions. As an example, *E. californicum* is the only species represented on the Santa Cruz Mountain peninsula, while no related form extends north of the Santa Barbara region. On this peninsula various climatic conditions are at hand, and if the glutinous and tomentose types simply represent more or less xerophytic conditions, we should find some indications of the two strains; but such is not the case. Plants have been observed associated with the madroño, California black oak, thimbleberry, and similar plants in mesophytic conditions, where the average annual rainfall is approximately 40 inches and where the rainless summers are ameliorated by frequent coast fogs. Other plants have been observed growing in typical xerophytic chaparral, where the annual rainfall is less than half as much and summer fogs very infrequent. The only difference detected between the plants from these two stations was found in the stature of the plants and in the size of the leaves.

It is not possible in this preliminary work to prove or disprove the "Jordan law," but it is evident that the species of *Eriodictyon* conform remarkably. We wish to reiterate, however, that mere

FIG. 2.—*Eriodictyon tomentosum* Benth.: type specimen in the Bentham Herbarium at Kew Gardens.

isolation has not been the primary factor in evolving these forms. That would hardly be argued by anyone. Isolation is no more a causal factor in variation or mutation than is artificial segregation, but like artificial segregation, as practiced by all breeders and experimental evolutionists, it is of prime importance in preserving new variations or mutations. We saw at the outset that our method of investigation was not such as to divulge the real underlying factors that have brought about the different forms of *Eriodictyon*. It must be supplemented with experimental studies, but whether it is possible to conduct these experiments successfully remains a future problem. For the present it has been our aim to ascertain, first of all, what forms exist in the group selected, and so far as possible where and under what conditions they grow. With data of this nature available, the experimental work can be undertaken by anyone with a clearer conception of the problem, and with more likelihood of interpreting rightly the results of his experiments.

ERIODICTYON Benth. Bot. Voy. Sulphur 35. 1844.

Low shrubs with thin shreddy bark and persistent, alternate, toothed or rarely entire leaves, tapering at the base to a more or less evident petiole, or sessile in one species, of firm coriaceous texture. Flowers in a terminal, usually naked, panicle of scorpioid cymes. Sepals linear, not enlarged above. Corolla funnelform to nearly campanulate, pale or dark violet or white. Filaments more or less adnate to the corolla and included, usually hirsute and of irregular length. Ovary 2-celled by the meeting of the dilated placentae in the axis. Capsule first loculicidal then septicidal, thus 4-valved, each valve with a short beak and closed on one side by the adherent dissepiment or half-partition. Seeds brown or black, finely reticulate with ridges running lengthwise, and connecting them many cross-bars.

A genus of eight species restricted to southwestern United States and adjacent Mexico, where they extend from southern Oregon and southern Nevada and Utah through Arizona and California to northern Lower California, but they belong essentially to the California element, and six of the species occur within and are practically confined to that state.

In addition to the species included in these studies, there are two other plants which were transferred by GREENE (**5, 6**) from

FIG. 3.—Distributional map of *Eriodictyon:* each species is given the same number as in the text; species 1–5 are outlined by an unbroken line and the stations cited in the text are marked by a circle; species 6–8 are outlined by a dotted line and the stations by a black dot.

Nama to *Eriodictyon*. *Nama Parryi* Gray agrees with typical *Eriodictyon* in seed character and essentially in fruit, and perhaps

should be placed here rather than in *Nama*, but it is an ill-scented herbaceous perennial of a totally different habit from true *Eriodictyon* and at least worthy of subgeneric distinction. The other species, *Nama Lobbii* Gray, has seeds merely muriculately papillose without any traces of longitudinal ridges, a seed character of the *Nama* type, and it is with that genus that it is most closely related.

Leaves petioled; herbage glutinous or tomentose, not hirsute.
- Herbage not grayish or hoary tomentose throughout; upper surface of the leaves glabrous and glutinous.
  - Branches glabrous and glutinous or those of the panicle sparsely pubescent; reticulations evident on the lower surface of the leaves.
    - Corolla tube about 12 mm. long, lavender-purple, much exceeding the nearly glabrous sepals ..... 1. *E. californicum.*
    - Corolla tube 5–7 mm. long, little or not at all exceeding the sepals, white.
      - Leaves mostly broadly lanceolate, not revolute; sepals densely pubescent; filaments adnate to the corolla tube half their length ..... 2. *E. trichocalyx*
      - Leaves mostly narrowly linear and revolute; sepals usually sparsely pubescent; filaments adnate one-third their length ..... 3. *E. angustifolium.*
  - Branches tomentose, becoming more or less denuded with age in *lanatum.*
    - Leaves lanceolate, firm-coriaceous and more or less revolute, densely white-tomentose beneath, obscuring the reticulations. 4. *E. lanatum.*
    - Leaves broadly oblanceolate, not revolute; sparsely soft-tomentose beneath; reticulations evident. 5*b*. *E. c. denudatum.*
- Herbage more or less densely tomentose throughout.
  - Calyx and corolla not glandular-pubescent; corolla not constricted at the throat.
    - Leaves densely covered with a silvery tomentum. 5. *E. crassifolium.*
    - Leaves clothed with a dull gray tomentum or sometimes nearly glabrous on the upper surface.. 5*a*. *E. crassifolium nigrescens.*
  - Calyx and corolla with stalked glands; corolla more or less constricted at the throat.
    - Stamens equaling the corolla tube, this slightly constricted at the throat ..... 6. *E. tomentosum.*
    - Stamens half as long as the corolla tube, this strongly constricted at the throat ..... 7. *E. Traskiae.*

Leaves sessile; herbage more or less hirsute..... 8. *E. sessilifolium.*

1. ERIODICTYON CALIFORNICUM (Hook. & Arn.). Torr. Bot. Mex. Bound. 148. 1859.

Wigandia californica Hook. & Arn. Bot. Beechy 364. 1840.
Eriodictyon glutinosum Benth. Bot. Voy. Sulphur 36. 1844.
Eriodictyon glutinosum var. *serratum* Choisy, DC. Prod. **10**:483. 1846.
Eriodictyon californicum forma *linearis* Brand, Univ. Calif. Pub. Bot. **4**:224. 1912.
Eriodictyon californicum subsp. *glutinosum* Brand, in ENGLER, Pflanzenreich **59**:141. 1913.
Eriodictyon californicum forma *latifolia* Brand, *loc. cit.*

An erect shrub 1–3 m. high, with mostly erect branches, the older branches and trunk clothed with light brown shreddy bark, the branchlets glabrate and glutinous, terete or sometimes angled: leaves lanceolate or oval, sometimes linear-lanceolate, 4–10 cm. long, 1–5 cm. wide, dentate or undulate, glabrous and glutinous above, whitened beneath with a fine indument between the reticulations, the midvein prominent, its main branches usually anastomosing at the margin; petioles gradually narrowed to the base, sometimes winged: branches of the inflorescence glabrous: sepals with a few scattered hairs or glabrous, linear, $\frac{1}{6}$ as long as the corolla: corolla funnelform, about 12 mm. long: stamens unequal, in sets of three long and two short or sometimes the reverse: style half as long as the corolla tube: capsule globular, usually covered with a white gum: seeds brown, about 6–12 maturing in a capsule.

BRAND'S two forms, *latifolia* and *linearis*, may occur in almost any locality where plants are subjected to different exposures. They are adjustments of the individual to local environmental conditions, and are not worthy of a taxonomic designation.

TYPE LOCALITY.—Described from specimens collected by DOUGLAS in the coastal region of central California, between Sonoma and Monterey.

DISTRIBUTION.—Inhabits the Upper Sonoran and Lower Transition zones, growing on clay, sandy, or rocky soils. Ranges from the southern end of the Sierra Nevada in Kern County and the Coast Ranges of San Luis Obispo County northward to the Siskiyou Mountains, where it reaches its northern limit, so far as known, in the vicinity of Wimer, Jackson County, Oregon. In the central Sierra Nevada it has been collected well within the Transition zone in Yosemite Valley (*Abrams* 4563) between Mirror Lake and Kenneyville, but associated with a number of other Upper Sonoran intruders. In the coastal

region it is seldom met with in the fog belt or typical redwood region, or again on the dry hot eastern slopes of the Inner South Coast Ranges.

SPECIMENS EXAMINED.—Oregon, Jackson County: Wimer, *Hammond* 291; Dunn's Butte, near Ashland, *Walpole* 250. Josephine County: Waldo, *Piper* 6215.

California.—Siskiyou County: hills west of Yreka, *Heller* 7996; dry thickets, near Yreka, *Butler* 1405. Humboldt County: Hupa Indian Reservation, alt. 500 ft., *Chandler* 1352; between Three Rivers and the mouth of Willow Creek, *Tracy* 3360. Mendocino County: near Cummings, *Davy* and *Blasdale* 5336; Round Valley, alt. 400 m., *Chestnut* 165; near Ukiah, *Bolander* 3912; *Purdy*, 1897. Tehama County: Cooper's South Fork of Elder Creek, *Ward* 108; Fort Reading, *Newberry*. Colusa County: College City, *Miss King* 1905. Butte County: Butte Creek, *Mrs. Austin* 1811; Little Chico Creek, *Mrs. Austin* 296. Plumas County: Shoo Fly Bridge, *Mrs. Austin*, August 1893. Lake County: Eel River, one mile below Hullville, *Heller* 6032; Clear Lake, *Torrey*, 1865. Sonoma County: Little Sulphur Creek, *M. S. Baker*, June 11, 1898. Marin County: Mount Tamalpais, *Michener* and *Bioletti*, May, 1892; *Eastwood*, May 30, 1898; Bolinas Ridge, *Palmer* 2339. Solano County: Putah Bluffs, *Jepson*, May 1891; Gates Cañon, near Vacaville, *Heller* and *Brown* 5380. Contra Costa County: northeast of Mount Diablo, *Brewer* 1133; southeast of Mount Diablo, *Brewer* 1158; Antioch, *Brandegee*, June 1908. Alameda County: Oakland, *Chestnut*. San Mateo County: Belmont, *Davy*, June 17, 1893; Lake San Andreas, *Elmer* 4801; King's Mountain road, *Miss Randall* 164; Searsville Ridge, *Dudley*, June 4, 1895. Santa Clara County: hillsides near Stanford University, *Dudley*, April 1893; between Saratoga and Los Gatos, *Dudley*, April 16, 1893; Black Mountain, *Rutter* 8; foothills west of Los Gatos, *Heller* 7384; near Stanford University, *Abrams*, May 1898, May 1901. Santa Cruz County: upper part of San Lorenzo road near the river, *Dudley*, May 7, 1893; Glennwood, *Horace Davis*, September 1907; Boulder Creek, *Bailey*, October 13, 1891; Soquel Gulch, *Mrs. B. H. Thompson*, June 7, 1902; Lorenzo Cañon, *Mrs. B. H. Thompson*, July 6, 1902. Monterey County: Monterey, *Parry*, 1850; Pescadero ranch, *Brewer* 670; near Mission Soledad, *Brewer* 583; Santa Lucia Mountains, *Plaskett*, May 1898; Tassajara, *Elmer* 3204. Calaveras County: Gwin Mine, *Jepson*, October 6, 1902. Amador County: Agricultural Station, alt. 2000 ft., *Hansen* 187; New York Falls, alt. 1500 ft., *Hansen* 1647; vicinity of Ione, alt. 200–500 ft., *Braunton* 102. Mariposa County: Mariposa, *Congdon*, June 1883; Yosemite Valley between Mirror Lake and Kenneyville, *Abrams* 4563; Kingsley, *Miss Hook*, May–June 1905. Madera County, Chiquito Creek, alt. 6000 ft., *Blethen*, June 30, 1912; North Fork and vicinity, *Griffiths* 4538. Tulare County: Giant Forest, *Brandegee*, August 1905. Kern County: North Fork of Kern River, alt. 750 m., *Coville* and *Funston* 1034; Kern River Cliffs, *Dudley* 767; vicinity of Havilah, *F. Grinnell* 275; Johnson's Cañon, Walker Basin, *F. Grinnell* 30, 116.

2. ERIODICTYON TRICHOCALYX Heller, Muhlenbergia 1:108. 1904.

Eriodictyon angustifolium pubens Gray, Proc. Am. Acad. 17:224. 1882.

Eriodictyon californicum subsp. *australe* Brand, ENGLER; Pflanzenreich 59:141. 1913, in part.

Eriodictyon californicum var. *pubens* Brand, *loc. cit.*

Eriodictyon glutinosum var. *intermedium* Parish, Brand, *loc. cit.*, published as a synonym.

Low shrub 0.5–1.5 m. high, with the erect branches and branchlets glabrous or nearly so and glutinous: leaves broadly lanceolate to linear-lanceolate, 5–10 cm. long, 1–3 cm. wide, firm coriaceous, flat and dentate or sometimes slightly revolute, glabrous and glutinous on the upper surfaces, paler beneath with a close fine tomentum within the conspicuous reticulations: branches of the inflorescence pubescent: calyx densely pubescent, nearly equaling the corolla tube: corolla 5–6 mm. long, its tube funnelform, white, densely pubescent without.

This species was first described by GRAY as a variety of *angustifolium*, but afterward (4) considered by him as one of the intermediate forms between that species and *californicum*. BRAND, basing the distinction mainly on the relative length of the free and adherent parts of the filaments, considered it as a variety of *californicum*, and restored *angustifolium* to specific rank. That the species is closely related to both *angustifolium* and *californicum* is evident, but the tendency to approach *californicum* is not through intergradation with typical *californicum*, but with *crassifolium nigrescens*. It is through this variety that all three of the species, *californicum*, *crassifolium*, and *trichocalyx*, form almost a complete series of intergradations. With this as the status of these forms, as demonstrated now by a large series of specimens, there are two ways of expressing their relationship taxonomically, either *crassifolium*, *trichocalyx*, and *californicum* should be considered as strains of a single species, or each should be given specific rank, and their more extreme geographical forms varietal rank, admitting that they do have a tendency to intergrade in contiguous territory. We have chosen the latter course because relationship can be shown sufficiently accurate by the simple binomial and trinomial method without the introduction of such burdensome combinations as *Eriodictyon californicum australe pubens coarctatum* Brand. Such combinations are as cumbersome as the pre-Linnaean system and less significant, for they need not be in any way descriptive.

TYPE LOCALITY.—"Seven Oaks Camp, San Bernardino Mountains."

DISTRIBUTION.—This species grows in stony or sandy soil in the chaparral of the San Gabriel and San Bernardino mountains. It extends from elevations of 1000 ft. on the sandy plains of the San Gabriel and San Bernardino valleys

to 8000 ft. on the south slope of San Antonio Mountain, and to nearly the same altitude on the south side of the divide between Seven Oaks and Bear Valley. On the desert slopes of the mountains it has been collected as low down as the juniper belt along Rock Creek.

SPECIMENS EXAMINED.—Los Angeles County: Mount Wilson, alt. 5600 ft., *Abrams* 2607; Claremont, *Chandler*, May 11, 1897; Rock Creek, desert slopes of the San Gabriel Mountains, *Abrams* and *McGregor* 526; Mount San Antonio, alt. 8000 ft., *Abrams* 1939, 2607. San Bernardino County: Lytle Creek, San Gabriel Mountains, alt. 800 m., *Leiberg* 3335; near San Bernardino, *Vasey* 438; *Coville* and *Funston* 107; sandy plains, near Colton, *Pringle*, May 27, 1882; Hogback, San Bernardino Mountains, *Parish* 2977 (approaching *crassifolium nigrescens*); Holcomb Valley, San Bernardino Mountains, *Shaw* and *Illingsworth* 85; Victorville, *Hall* 6188. Riverside County: Banning, *Brandegee*, May 14, 1895; Whitewater, alt. 1126 ft., *Parish* 2976. Lower California: no locality, *F. E. Fish*, May 7, 1883 (this is herbarium sheet no. 45671 of the National Herbarium. The locality is not given and two labels are attached, one purporting to be ORCUTT'S and the other FISH'S, but neither is apparently original. The specimens are not in flower, but seem to belong here); near Ensenada, *Jones* 3739 (this plant together with a specimen collected by *Brandegee*, May 20, 1893, on San Pedro Martir Mountain, BRAND described as *californicum* subsp. *australe* var. *pubens* subvar. *coaractatum*. *Jones's* specimen may well be placed with *trichocalyx*, although the specimen at hand is too scrappy to warrant more than a guess, but *Brandegee's* specimen is strikingly different. It is much like typical *angustifolium* in foliage characters and size of flowers, but the filaments are a little more united to the corolla tube. In this respect it seems intermediate between *angustifolium* and *trichocalyx*).

3. **Eriodictyon lanatum** (Brand) Abrams, sp. nov.

Eriodictyon californicum subsp. *australe* var. *lanatum* Brand, in ENGLER, Pflanzenreich **59**:142. 1913.

An erect branching shrub, 0.6–2 m. high, with the branches more or less permanently tomentose: leaves thick coriaceous, slightly revolute on the entire, undulate or dentate margins, 2–7, mostly about 5, cm. long, 8–20 mm. wide, tapering from near the middle to both ends, glabrous and glutinous above, at least in age, densely covered beneath with a white tomentum obscuring the reticulations: branches of the inflorescence pubescent; flowers crowded in the scorpioid cymes: sepals densely white-pubescent, about 2.5 mm. long: corolla funnelform, 7–8 mm. long, much exceeding the calyx, pale purplish-blue or nearly white, the tube pubescent without.

TYPE.—The type of the variety is *Abrams* 3632, collected in chaparral between Campo and Jacumba. The description of the species is drawn from a sheet of the same collection deposited in the Dudley Herbarium.

DISTRIBUTION.—Southern California from the vicinity of Toro Mountain, Riverside County, southward through the chaparral region, especially on the desert slopes of the Cuiamaca Mountains, to the northern boundary of Lower California.

SPECIMENS EXAMINED.—Riverside County: near Toro Mountain, *Leiberg* 3199. San Diego County: Jacumba Hot Springs, *Mearns* and *Schoemfeldt* 3261, 3288; Mountain Springs, *Mearns* and *Schoemfeldt* 3207; Cameron's ranch, Laguna, *Mearns* and *Schoemfeldt* 3702; San Felipe, *Brandegee*, April 16, 1895; Colorado Desert, in the foothills, *Brandegee*, April 13, 1896; Potrero, *Alderson*, May 1893; Palm Creek, Colorado Desert, *Brandegee*, April 18, 1895; Laguna Mountains, *Brandegee*, June 20, 1904; in chaparral between Jacumbo and Campo, *Abrams* 3632; Campo, *Hall* 9424. Lower California: Nachoguero Valley, *Mearns* and *Schoemfeldt* 3463.

4. ERIODICTYON ANGUSTIFOLIUM Nutt. Jour. Acad. Nat. Sci. Phil. II. 2: 181. 1848.

Eriodictyon glutinosum angustifolium Torr., GRAY, Syn. Fl. 2: 176. 1878.

Low erect shrub, 0.6 to 2 m. high, the branches often crowded, glabrous and glutinous: leaves narrowly linear to narrowly linear-lanceolate, 5–10 cm. long, 3–10 mm. wide, entire or inconspicuously dentate, revolute, glabrous and glutinous above, canescent and reticulated beneath: branches of the inflorescence glabrous and glutinous or sparsely pubescent: cymes racemosely or corymbosely arranged: sepals linear, nearly glabrous or somewhat hirsute: corolla nearly campanulate, its tube only about 5 mm. long, not exceeding the calyx: filaments united only $\frac{1}{3}$ their length: seeds black, slightly longer than those of *californica*.

TYPE LOCALITY.—"On the Sierra of Upper California [Arizona]."

DISTRIBUTION.—In the Upper Sonoran chaparral of southern Nevada and southern Utah southward through Arizona, and also in Lower California in the San Pedro Martir region.

SPECIMENS EXAMINED.—Utah: Silver Reef, alt. 3500 ft., *Jones* 5149, 5176; nearly at the head of the grade 5 miles above Bellevue, *Jones* 5001; Sandy, 4 miles east of Leeds, alt. 3400 ft., *Jones* 5214. Nevada: Charleston Mountains, alt. 4000–5000 ft., *Purpus* 6074; Bunkerville, Virgen River, *Goodding* 746. Arizona: Diamond Valley, *Purpus*, May–October 1898; "hills near Cactus Pass in the western part of New Mexico" (probably in western Arizona on Bill Williams Fork), *Bigelow*, 1853; Pinal Mountains, *Jones*, May 24, 1890;

Oak Creek, *Rusby* 239; no locality, *Palmer*, 1869; Santa Catalina Mountains, *Lemmon*, May 1881; Copper Basin, *Toumey* 199-*b;* Cheno Valley, *Toumey* 199-*a;* canyon 2 miles below Pagumpa, alt. 4000 ft., *Jones* 5089. Lower California: Trinidad Valley, *Belding*, May 1885; Vallederos Creek, *Brandegee*, May 29, 1893; San Pedro Martir Mountain, *Brandegee*, May 4 and 20, 1893.

5. ERIODICTYON CRASSIFOLIUM Benth. Bot. Voy. Sulph. 35. 1844.

Eriodictyon tomentosum of various authors, not Benth.

Eriodictyon crassifolium subsp. *Grayanum* Brand, in ENGLER, Pflanzenreich 59:139. 1913.

Eriodictyon crassifolium var. *typica* Brand, *loc. cit.*

Shrub 1–4 m. high, with spreading branches, the twigs, both surfaces of the leaves, and calyx densely hoary or silvery tomentose: leaves 7–15 cm. long, 2–5 cm. wide, reticulate beneath, not revolute, entire or crenate, dentate or sometimes shallowly lobed: sepals about 5 mm. long, narrowly linear: corolla 10–15 mm. long, rather broadly funnelform, pale bluish purple, pubescent without: seeds smaller than in *californicum* and indented.

TYPE LOCALITY.—"San Diego."

DISTRIBUTION.—Typical *crassifolium* inhabits the dry gravelly or sandy mesas and foothills in the vicinity of San Diego and extends northward to Santiago Canyon, Santa Ana Mountains, in the coastal region, also on the mesas and foothills between the Santa Ana and the San Jacinto mountains, where it extends to the desert slope in the vicinity of Palm Springs. In the Los Angeles region, extending along the coastal slopes of the San Gabriel Mountains to the Santa Monica and San Fernando mountains, the leaves are covered with a somewhat less dense and shorter tomentum, giving a dull gray instead of a hoary tone. These plants often have the flowers reduced in size and grade fairly gradually into the variety *nigrescens*. This more or less intermediate type extends on northward to the Tehachapi region.

SPECIMENS EXAMINED.—Kern County: San Emidio Canyon, *Davy* 2026; San Emidio Potreros, alt. 5000 ft., *Hall* 6391; vicinity of Fort Tejon, *Xantus de Vesey* 94; Canada de las Uvas, alt. 1050 m., *Coville* and *Funston* 1142. Los Angeles County: Mount Lowe, *Grant* 417; Little Santa Anita Canyon, *Abrams* 2627; San Fernando Mountains, near Chatsworth, *Abrams* 1363; Santa Monica Mountains, *Hasse*, June 1892; Los Angeles, *Brewer* 39; Glendora, *Braunton* 293. Orange County: Santiago Canyon, *Miss Bowman*, June 1899; *Hall* 9402. Riverside County: western base of the San Jacinto Mountains, *Hall* 2006; Hemet, *Hall* 561; Valle Vista, San Jacinto Mountains, *Hall* 1107; Elsinore, *Abrams* 5052; Tahquitz Canyon, near Palm Springs,

Dudley, December 25, 1903; near San Jacinto, *Leiberg* 3214; *Berg*, April 3, 1904; Menifee, *Miss King*, 1893. San Diego County: San Diego, *Barclay* (type); *Cooper* 498; *Palmer*, 1875; *Pringle*, April 26, 1882; *Dunn*, April 21; *Jones* 3143; Mission hills, near San Diego, *Abrams* 3432; Point Loma, *Chandler* 5067 (this specimen resembles the less tomentose form of the Los Angeles region, a condition undoubtedly due to the greater humidity on the promontory than on the adjacent mainland); Encinatas, *Brandegee*, March 28, 1894; Witch Creek, *Alderson*, April 1894; San Ysabel, *Henshaw* 148; near Bennington, *Dudley*, January 1908.

5*a*. ERIODICTYON CRASSIFOLIUM NIGRESCENS Brand, in ENGLER, Pflanzenreich **59**: 140. 1913.

Leaves smaller and comparatively narrower, dull gray green with a shorter and much less dense tomentum, usually crenate-dentate: corolla narrowly funnelform, about 6 mm. long, white and densely hairy without.

This variety is intermediate between *crassifolium* and *trichocalyx*. The intergradation with typical *crassifolium* is complete but less marked with *trichocalyx*, although the form originally described by GRAY as *angustifolium* var. *pubens* partakes of both and might be placed in either category.

TYPE LOCALITY.—Acton, Los Angeles County.

DISTRIBUTION.—Chaparral-covered slopes of the Liebre and San Gabriel mountains, especially in the Soledad Pass region.

SPECIMENS EXAMINED.—Acton, *Elmer* 3596, 3598; Kings Canyon, Liebre Mountains, *Dudley* and *Lamb* 4343; Oakgrove Canyon, Liebre Mountains, *Abrams* and *McGregor* 322.

5*b*. ERIODICTYON CRASSIFOLIUM **denudatum** Abrams, var. nov.

Leaves 10–15 cm. long, 2–3.5 cm. wide, flat and more or less dentate on the margins, green and glabrate but not evidently glutinous on the upper surface, soft tomentose beneath, as also the branches and inflorescence: calyx densely clothed with silky hairs, about one-third the length of the corolla tube: corolla lavender, densely pubescent without, 8–10 mm. long.

This variety is the extreme type of the *crassifolium* group; it merges into the variety *nigrescens* and through the Los Angeles form into typical *crassifolium*, while the denuded upper surface of the leaves suggest close affinity with *californicum*. It occurs in the cross ranges of Santa Barbara and Ventura counties, the region from whence *californicum*, *crassifolium*, and *trichocalyx* diverge. It is natural, therefore, according to the Jordan law, that we should find here the intermediate forms.

TYPE.—Red Reef Canyon, Topatopa Mountains, alt. 2800–3500 ft., Ventura County, California, *Abrams* and *McGregor* 159, June 8, 1908. The type sheet is deposited in the Dudley Herbarium of Stanford University.

DISTRIBUTION.—Chaparral-covered hills and mountains of Santa Barbara and Ventura counties.

SPECIMENS EXAMINED.—Santa Barbara County: Santa Inez Mountains, near Santa Barbara, *Brandegee*, 1888. Ventura County: Ojai and vicinity, *Peckham*, April 13, 1866; Sisar Canyon, Topatopa Mountains, *Abram* and *McGregor* 65; Red Reef Canyon, Topatopa Mountains, *Abrams* and *McGregor* 142, 159. Kern County: Vicinity of Fort Tejon, *Abrams* and *McGregor* 300 (approaches the Los Angeles form of *crassifolium*).

6. ERIODICTYON TOMENTOSUM Benth. Bot. Voy. Sulph. 36. 1844.

Eriodictyon niveum Eastw. Proc. Cal. Acad. III. 1:130. 1898.

Eriodictyon crassifolium subsp. *Benthamianum* var. *niveum* Brand, in ENGLER, Pflanzenreich **59**:140. 1913.

An erect, branching shrub with the herbage hoary throughout with a dense feltlike tomentum or rarely becoming more or less denuded and green: leaves thick, elliptic-ovate or obovate, 4–6 cm. long, 1–3 cm. wide, cuneate at base, acute or obtuse at apex, entire, crenate, or even coarsely dentate, veins scarcely evident on the upper surface, beneath reticulate-rugose; panicle terminating a usually elongate naked peduncle widely branched or simple; flowers crowded, nearly sessile: calyx lobes linear-subulate, equaling the corolla tube, clothed with white silky hairs with a few stalked glands interspersed: corolla white or pale violet, 4 mm. long, urceolate, glandular-hirsute without, the tube slightly contracted below the very short spreading lobes: stamens with the free portion of the filaments short, inserted below the throat; anthers oval 1 mm. long.

Until now the identity of *E. tomentosum* has been misunderstood. TORREY (**9**) first considered it and *crassifolium* as conspecific, with the remark, "We have specimens that are intermediate and Dr. PARRY informs me that he has seen them in California passing into each other." We have failed to find in the field or in any of the herbaria any intermediate forms, nor is there any evidence that PARRY ever collected true *tomentosum*. Geographically and structurally, aside from the superficial character of hoariness, these two species are more distinct than *crassifolium* and *californicum*. TORREY'S conclusions were followed by GRAY and other botanists until GREENE (**6**) discovered a plant in Monterey County which he believed to be the true *tomentosum*.

Miss EASTWOOD, red scovering the same plant and wishing to solve the problem, sent specimens of her Monterey plant and also *crassifolium* material from San Diego to Kew to be compared with the types. The person at Kew who investigated the matter for her replied that "*Eriodictyon crassifolium* and *E. tomentosum* are conspecific, and your plant is apparently an undescribed species." This seemed final, but from our distributional studies we found that the northern limit of true *crassifolium* is far south of the region visited by DOUGLAS, who first collected *tomentosum*. We know that DOUGLAS collected in the vicinity of Mission San Antonio where *niveum* is found, and about Santa Barbara where *Traskiae* and *crassifolium denudatum* grow. Which of these was the true *tomentosum* was not evident without access to the type, but that one of them and not *crassifolium* would prove to be it seemed probable. We wrote, therefore, to Dr. OTTO STAPF, of the Kew Herbarium, who furnished us with a photograph of the type of both *crassifolium* and *tomentosum*, and also fragments for study. The evidence was clear; *tomentosum* and *niveum* were found to be one and the same.

TYPE LOCALITY.—Not given in the original publication, but collected by DOUGLAS probably in the vicinity of Mission San Antonio, Monterey County.

DISTRIBUTION.—On the chaparral-covered eastern slopes of the Santa Lucia Mountains, extending southward through the middle foothill region of Monterey and San Luis Obispo counties.

SPECIMENS EXAMINED.—Monterey County: without locality but probably from the Jolon region, *Douglas* 1833; Jolon, *Vasey* 439; *Mrs. K. Brandegee*, June 8, 1909; Tassajara Hot Springs, *Elmer* 3210; San Antonio Creek, above the Mission, *Dudley*, May 11, 1895; Cholome, *Lemmon;* Arroyo Seco, Santa Lucia Mountains, *Dudley*, January 1, 1896; China Camp, on road to Tassajara Hot Springs, alt. 3500 ft., *Cox*, July 1908; near Soledad, *Congdon*, June 1881. San Luis Obispo County: between Pozo and La Panza, *Miss Eastwood*, June 10, 1902; Santa Margarita Mountains, east of pass on road to San Luis Obispo, *Dudley*, April 3, 1903; central coast ranges, *Palmer*, 389.

7. ERIODICTYON TRASKIAE Eastw. Proc. Cal. Acad. III. 1:131. 1898.

Eriodictyon crassifolium subsp. *Benthamianum* var. *Traskiae* Brand, in ENGLER, Pflanzenreich **59**:140. 1913.

An erect branching shrub 1–2 m. high, clothed with a hoary feltlike tomentum except on the calyx: leaves oblanceolate to elliptic-ovate, 5–12 cm. long, 1.5–4 cm. wide, acute at apex, narrowed at base to a petiole 1 cm. long or more, dentate, veins obscure on the upper surface, reticulate-rugose beneath: panicle usually much branched, bearing short congested terminal cymes, or these elongated; flowers short-pediceled, crowded: sepals

narrowly linear, 4–5 mm. long, dark colored, and glandular-hirsute: corolla purple, the tube equaling the calyx, contracted at the throat and base: the lobes irregularly orbicular, these and the upper part of the tube glandular-hirsute without: stamens inserted in the middle of the tube, nearly sessile: ovary glandular-hirsute.

This species is closely related to *tomentosum* and possibly should be considered a variety. The two are best differentiated by the position of the stamens.

TYPE LOCALITY.—"On one volcanic upland on Santa Catalina Island, California, at an elevation of about 1500 feet."

DISTRIBUTION.—Santa Catalina Island and on the mainland in the Santa Inez Mountains, Santa Barbara County. Why it should occur in practically unmodified form on the mainland and the islands is not easily explained, although the fact that it is found on the islands in only one station and that composed of only a few bushes would indicate that it had been transported, possibly by birds of passage, from the mainland. It is significant in this connection that a number of insular species are also found on the mainland in the Santa Barbara region.

SPECIMENS EXAMINED.—Santa Barbara County: Painted Cave ranch, *Eastwood*, May 9, 1908; Sisquoc, *M. S. Baker*, July 1895; La Cumbre trail, Santa Inez Mountains, *Abrams* 4311; Santa Inez Mountains, *Eastwood*, May 17, 1904; *Hall* 7845; bushy hills, head of Santa Inez River, *Hall* 7830; near Santa Barbara, *Brewer* 296; *Elmer* 4017; *Brandegee*, 1888. Los Angeles County: Santa Catalina Island, *Blanche Trask*, May 1897 and September 1910.

8. ERIODICTYON SESSILIFOLIUM Greene, Bull. Cal. Acad. Sci. 1:201. 1885.

A shrub 1–2 m. high with very leafy glandular-pubescent and hirsute branches: leaves lanceolate-oblong, 6–12 cm. long, 2–4 cm. wide, acute at apex, sessile and truncate or cordate-clasping at base, coarsely serrate, glutinous and nearly glabrous to densely hirsute on the upper surface, sparsely to densely hirsute beneath and short-tomentose between the veins: inflorescence an open or somewhat congested cymose panicle: sepals villous-hirsute and glandular, about 5 mm. long: corolla funnelform, 12 mm. long, lilac-purple, pubescent without but not glandular: stamens equal, their filaments densely clothed with bristly hairs: capsule globular: seeds dark brown or nearly black.

Considerable variation in the amount of hirsute pubescence suggests a plastic condition or possibly two varietal strains, but too few collections have

been made and too little is known of its geographical range to warrant any new propositions to designate these forms.

TYPE LOCALITY.—"All Saints Bay, Lower California."

DISTRIBUTION.—On canyon slopes in the coastal region of northern Lower California, especially in the neighborhood of Ensenada.

SPECIMENS EXAMINED.—Lower California: Todas Santas, *Fish*, June 2, 1883; La Gruella Canyon, *Orcutt*, July 14, 1885; Guadaloupe Canyon, *Orcutt*, January 20, 1882, and June 2, 1883; Burro Canyon, *Brandegee*, April 22, 1893.

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